



Design of Bulk Built-In Current Sensors to Detect Single Event Effects and Laser-Induced Fault Injection Attempts

Jean-Max Dutertre, Rodrigo Possamai Bastos, Olivier Potin, Marie-Lise Flottes, Giorgio Di Natale, Bruno Rouzeyre

► To cite this version:

Jean-Max Dutertre, Rodrigo Possamai Bastos, Olivier Potin, Marie-Lise Flottes, Giorgio Di Natale, et al.. Design of Bulk Built-In Current Sensors to Detect Single Event Effects and Laser-Induced Fault Injection Attempts. Joint MEDIAN–TRUDEVICE Open Forum, Sep 2014, Amsterdam, Netherlands. 2014. emse-01099040

HAL Id: emse-01099040

<https://hal-emse.ccsd.cnrs.fr/emse-01099040>

Submitted on 7 Jan 2015

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

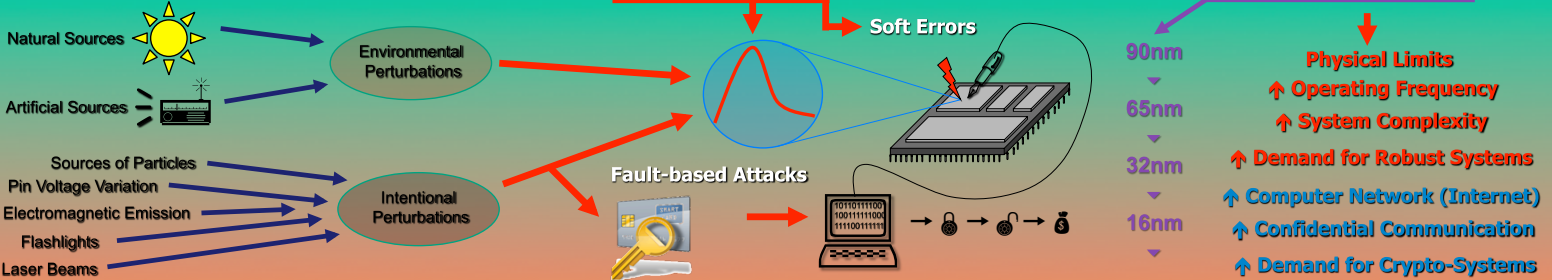
L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Design of Bulk Built-In Current Sensors to Detect Single Event Effects and Laser-Induced Fault Injection Attempts

(2) J.-M. Dutertre¹, R. Possamai Bastos², O. Potin¹, M.-L. Flottes³, G. Di Natale³, and B. Rouzeyre³

Bulk Built-In Current Sensors (BBICS) are fault detection mechanisms embedded in integrated systems. BBICS are able to monitor anomalous transient currents like the so-called single event effects induced by radiation or even malicious injection sources. This work reviews BBICS principles and introduce new sensor architectures that improve the transient-fault detection sensitivity. In addition, a test chip is presented for the validation of the sensor concept under the laser-induced effects.

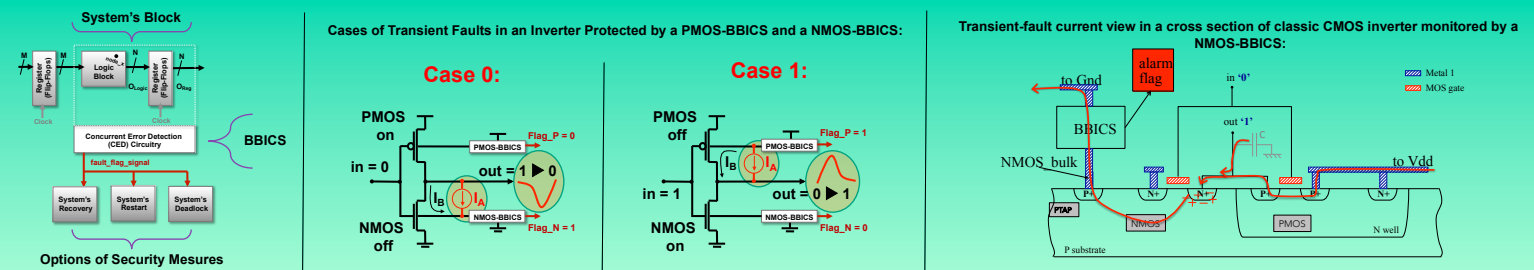
Integrated circuits are more and more Transient-Fault (TF) sensitive through new technologies



The today's trend in efficient protections against transient faults:



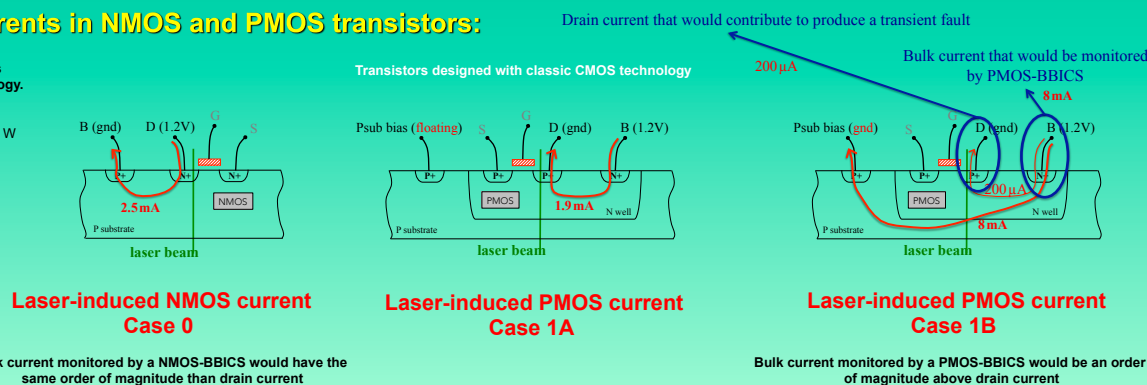
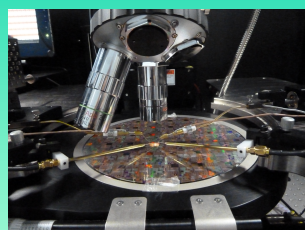
Mitigation of Transient faults by using CED schemes based on Bulk Built-In Current Sensors (BBICS):



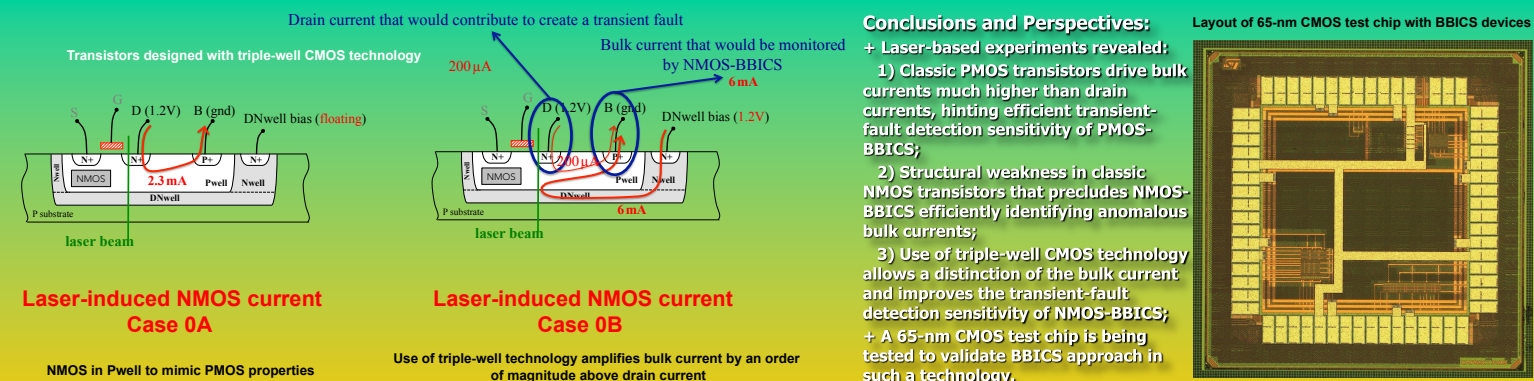
Analysis of laser-induced currents in NMOS and PMOS transistors:

Test chip composed of single NMOS and PMOS transistors designed with classic and triple-well 90-nm CMOS technology.

Experiment settings: measure of laser-induced currents at $\lambda = 1064$ nm, laser spot $\varnothing = 5$ μ m, pulse duration = 20 μ s, 1.25 W



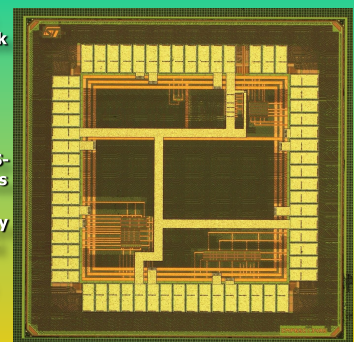
Improving the transient-fault detection sensitivity of BBICS by using triple-well CMOS technology:



Conclusions and Perspectives:

- + Laser-based experiments revealed:
- 1) Classic PMOS transistors drive bulk currents much higher than drain currents, hinting efficient transient-fault detection sensitivity of PMOS-BBICS;
- 2) Structural weakness in classic NMOS transistors that precludes NMOS-BBICS efficiently identifying anomalous bulk currents;
- 3) Use of triple-well CMOS technology allows a distinction of the bulk current and improves the transient-fault detection sensitivity of NMOS-BBICS;
- + A 65-nm CMOS test chip is being tested to validate BBICS approach in such a technology.

Layout of 65-nm CMOS test chip with BBICS devices



¹Centre Microélectronique de Provence - Georges Charpak, Gardanne, France (dutertre@emse.fr)

²Université Grenoble Alpes, CNRS, Laboratoire TIMA, Grenoble, France (bastos@imag.fr)

³LIRMM (Université Montpellier II / CNRS UMR 5506), Montpellier, France ({flottes, dinatale, rouzeyre}@lirmm.fr)